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# MICROCOMPUTERS FOR NURSERYMEN

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## INTRODUCTION

The two major divisions of a computer system are hardware and software. Hardware consists of the physical components of the system while software comprises the various types of instructions necessary for a computer to perform useful work. Hardware developments in computers have been expanding at a rapid rate. One could even say "exploding". This is especially true in the lower cost range, often referred to as personal and game commputers. These rapid developments have made the distinctions between classes of computers very difficult to define. Keeping in mind these difficulties, most in the computer industry would never-the-less classify computers as: mainframe, mini-computers, personal computers, and game computers. In classifying, however, one must remember that things are always changing. For example, a top of the line "personal computer" now has as much and in many cases more capacity than a small "mainframe computer" of a decade ago. A mainframe computer is generally considered a very large machine costing into the millions of dollars. It is very fast, multi-user,

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multi-task, multiple input/output devices, many units of various types of storage devices, and an array of very fast printers. A mini-computer is also a very capable machine usually, costing tens of thousands or hundreds of thousands of dollars, fast, multi-user, multi-task, several input/output devices with one or more medium or high speed printers. While remaining very capable, it would have less capability than a mainframe unit. Developments in the personal computer area have been especially rapid. Personal computers normally range in cost from less than $1,000 to about $10,000, are normally single user with some of the more expensive units being able to handle multi-users, single task or in some cases multi-task, have limited input/output devices and usually one printer. They normally sit on a desk top or in a specially designed desk configuration and are essentially designed for one user. Their main purpose has been to meet the needs of small businesses and professional people. They also have been used heavily in school systems. The game computer normally costs less than $500, might hook into the home television set or have its own visual display unit, and may or may not have a printer. At the present time, home computers are used primarily for games, hobbies, tutoring children, etc. Their capacity is, however, increasing rapidly. It is apparent that cost directly correlates with the capabilities of a computer. Personal computers and home computers are often considered "computers on a chip". This is because their "brains" or central processing systems are often contained on a

single piece of silicon about 1/4 of an inch square. This discussion will concentrate primarily on the personal computer.

Top of the line personal computers are now set-up to handle multi-language input and output, have CPU's (Central Processing Systems) that handle either 8, 16, or even 32 bytes of information at a time, memories ranging from 65,536 to over ten million characters (64K to 10M bytes), diskette drives that can read either one or two sides of diskettes, diskettes that may be either single, double, or quadruple density with capacities ranging from 100K to one or more megabytes, hard disks with capacities ranging from 5M to 500 Mbytes, new lazer (CDROM) disks with even more speed and capacity, visual display units with very high resolution of more than 960 by 240 pixels, and dot matrix, "letter quantily", and/or lazer printers that are fast, accurate, and provide excellent copy. The best of these units are indeed, very capable computers. Personal computers are also being made very compact and can be further grouped as desktop, luggable and laptop.

One term often used to describe the capacity of a computer is "how many K's does it have". A "K" literally stands for kilo or 1,000, but because of how a computer "thinks" it is a term used to represent multiples of 1,024 bytes. A byte represents eight bits and is usually the amount of capacity needed to represent an alphameric character (both alphabetic characters 'letters' and numeric 'digits' plus special characters such as punctuation marks). A computer works with binary numbers (uses the digits 0 and 1 and has the base two). The number 1,024 is 2 raised to the

tenth power. A 64K computer therefore has (64 x 1,024), or 65,536 bytes (alphameric characters) of addressable memory (main storage) locations. A "M" literally stands for mega or million. In computer language, however, it stands for 1,048,576 bytes of information (1000K bytes). Another way of comprehending computer capacity is to realize that it takes approximately 1.5 Kbytes to hold one double spaced typewritten page (in main memory or in storage), which translates into 150 Kbytes to hold 100 double spaced typewritten pages. A 64K computer usually means there is 64K of random access memory (RAM) available that can hold up to about 43 double spaced typewritten pages of information. It should be noted, however, that all 43 pages are not available to the user as part of RAM is normally taken up by portions of the computer's operating system and the program being run. Obviously, the size of the memory (ROM and RAM) plays a critical role in selecting a computer. A discussion of hardware for personal computers can be broken down into: (1) CPU, (2) memory, (3) storage, (4) keyboard, (5) visual display, and (6) printer.

## CENTRAL PROCESSING UNIT (CPU)

The CPU or central processing unit is the brain of a computer. It contains the circuits which control the interpretation and execution of instructions and consists of the control section and arithmetic/logic unit of the computer. Many would also consider the memory to be part of the CPU, but in this discussion it will be

handled separately. In disucssing personal computers one often hears of either 8, 16, or 32 bit CPU's. This essentially means that the computer can either handle (move) 8, 16, or 32 bits of information at a time. The advantage of more bits moved at a time is faster operation. While there are many complicating factors, a lay person could essentially consider a 32 bit CPU as being four times as fast as an 8 bit CPU. A few of the most capable personal computers now have 32 bit CPUs and computer experts expect 64 bit CPUs to be introduced in the near future.

## MEMORY

Memory, also known as main or primary storage, consists of electronic or magnetic cells, each of which can contain information. It is very similiar to the human brain. The CPU has direct access to memory and is the location where instructions and data are placed for access by the CPU. After data is processed by the CPU, the results are also first stored in memory. The CPU can interact very rapidly with memory since everything is stored electronically and there are usually no moving parts within the CPU and memory. Memory in personal computers is often divided into ROM (read only memory) and RAM (random-access memory). ROM is storage that cannot be changed by the computer user and consists of nonalterable programs and constants. If one compares it to a calculator, it would be like the "square-root key". When one purshes the "square-root key" on a calculator, the calculator

executes a "ROM" program that takes a number in display and converts it to its square root. Usually the more nonalterable programs and constants in ROM, the more useful and automatic the computer. RAM is memory that is directly useable by the computer operator. During the execution of a program, it will often contain system operating instructions, application program instructions, and data. RAM is memory that can be easily erased. In fact, in most personal computers RAM is automatically erased when the power is turned off. When one refers to a 16K, 32K, 64K, 256K, 640, and/or megabyte(s) personal computer they are usually referring to RAM memory. The amount of RAM available is important to the personal computer user because it defines the limits to program and data that can be interacted with by the CPU at one point in time. The larger the useable RAM, the larger the work section can be. It is useful to refer to useable RAM because the operating system often consumes part of RAM. In some personal computers a lot or all of the operating system is in ROM, but in the majority, at least part of it is contained on diskettes that must be loaded into RAM. One highly positive feature of RAM is that it has become cheap when compared to other computer components. It is a fraction of the costs per unit of capacity when compared to a few years ago. A 16K personal computer used to be considered a rather large machine. Now we would not advise a nurseryman to purchase a personal computer with less than 256K. An important feature when considering purchase of personal computers is memory expandability.

While a 256K machine may see quite adequate to begin with, it would be nice and perhaps essential to be able to expand it several times beyond its original capacity. Most good personal computers have the capacity to expand memory. The CPU and memory considered together make up the main portion of a computer, with all the other pieces of hardware known as peripherals. Every computer will contain a CPU and memory, but the types and numbers of peripherals differ greatly. Since memory in RAM is normally erased (there are exceptions, especially in laptops) as soon as the computer is turned off and because RAM capacity is relatively expensive when compared to other means of storage, secondary storage devices are provided. This allows data and information that has been developed in memory (primary storage) to be stored in a permanent or semi-permanent storage media.

## STORAGE

Storage differes from memory (also known as primary or main storage) in that it is secondary and data from storage must be "loaded" into memory before it can be directly accessed or used by the CPU. While magnetic tape is a storage device used by some personal computers (primarily for backing up harddrives), the most used media is magnetic floppy disks or diskettes that are loaded into diskette units when needed. A fairly recent development, the last four years, is the hard disk which is faster, more durable, reliable, and generally holds many times as much information as floppy disks or diskettes. The cost for hard disks has decreased

rapidly. Three years ago, a 5 Mbyte hard disk might have cost more than $3,000, while today a 20 Mbyte hard disk can be obtained for less than $500. A floppy disk unit usually has the capacity to hold one or more diskettes, has a readwrite head for each diskette surface, and a disk drive to turn the diskettes. The diskettes are turned at a relatively high rate of speed (about 300 revolutions per minute) and the read/write head moves in and out thereby having the ability to reach any portion of data demanded by the computer. A diskette or hard disk operates like RAM in that it is random access and can be changed. The data on a diskette or hard disk however, is semi-permanent in that it is only erased and/or changed upon demand, but is not erased when the computer is turned off or if power is lost. Diskettes hold from 50K (approximately 33 double spaced typewritten pages) to over 1 Mbytes (approximately 667 double spaced typewritten pages) and are relatively cheap, costing from about $0.30 to $10 per diskette. Diskettes may have information stored on either one side or both sides and may be either single, double, or quadruple density. Of course the capacity of a diskette is maximized when it is double sided, quadruple density. Since the diskettes are exchangeable on the disk units, unlimited amounts of storage can be achieved by having multiple diskettes. If certain computer programs require large amounts of instructions and/or data readily available to be loaded into memory upon command, then multiple disk drives can be provided. If mass storage is needed, however, a nurseryman should

seriously consider acquiring either one or more hard disks. In fact, if a nurseryman is considering a personal computer for his/her business, a hard disk should be one of the specifications. A 20 Mbyte hard disk, for example, will hold the equivalent of about 13,600 double spaced typewritten pages. Additional forms of storage are the Benouli Box and the lazer disk. The Benouli Box allows the exchange of high capacity floppy disks (encased in hard plastic shells) in a system, while the lazer disk provides for even greater amounts of storage and higher speeds for retrival. Currently there are two forms of lazer storage disks. The first is known as CDROM (Compact Disk Read Only Memory). These act much like the compact disks used in late model record players. They can be read repeadly, but cannot be written on. The second is known as WORM (Write Once Read Memory). In these units the user can write on the disk once and then repeadly read from it. One cannot, however, write on it a second time. RAM (Random Access Memory) where one can repeadly read and write on a disk is not yet commercially available based on lazer technology.

## KEYBOARD

The keyboard consists of the set of keys on a unit that allows alphanumeric characters or symbols to be transmitted when the keys are depressed. It inputs instructions and text to the computer. The keyboard always interacts with the CPU and memory. Information from the keyboard enters memory and then can be stored, if desired, for later use in a storage media by using peoper commands to the computer. The keyboard usually contains the same keys one finds

on a typewriter, plus special function keys to control the computer, and often a number pad like the ones found on calculating machines. Some keyboards have only upper case letters while others have both upper and lower case. It may either be attached to the main body of the computer or be separate so that it can be used in various positions away from the main body of the computer. Keyboards on, top of the line, personal computers can be set-up to compose thesymbols for practically all modern languages. Some computers, in conjunction with software, can even have special figures composed such as unique mathematical symbols.

## VISUAL DISPLAY

Visual diplays are the television like screens information is displayed on. Signals from the keyboard go into memory and are reflected on the screen. Video screens vary considerably in their capability; they be either black and white (also green and white or other colors) or colored, range in size from two or three inches diagonally to 14 inches and larger, be high or low resolution, display from 40 to 132 or more columns by 10 to 25 and more rows. An industry standard is developing that calls for screens displaying at least 80 columns by 25 rows. Some of the top of the line personal computer monitors will display either 80 or 132 and more columns by 25 plus lines. They have high resolutions that display pictures and other graphics in considerable detail.

Resolution is often measured by the number of pixels that are available on a screen. Some personal computers have standard bit-mapped resolutions as high as 960 x 240 pixels (picture element that is one point on a screen), which can support excellent quality graphics. Television quality resolution is about 320 x 240 pixels. Another feature of high quality video screens is split screen windows capability wherein various parts of a large file or piece of information can be examined at various critical points. Black and white (green and white, etc.) video screens supporting at least 80 column by 24 row displays should be adequate for most applications.

## PRINTER

Printers come in all kinds of shapes, sizes and capacities. Two major divisions for personal computers are dot matrix and letter quality which can be further grouped into impact and lazer. Dot matrix printers are cheaper, faster and less prone to mechanical break down than is the case with letter quality printers. Letter quanlity printers on the other hand produce better copy. Some high quality dot matrix printers will print up to a rate of 240 characters per second (2400 words per minute), print bidirectional, have various internal typewritter style character fonts and international character sets, have variable horizontal character densities and vary the number of lines per vertical inch, etc. Dot matrix printers for personal computers

start at about $200 and range to over $3,000 depending upon speed and other capabilities. Letter quality printers for personal computers start at about $300 and range to over $6,000 again depending upon capabilities. A letter quality printer, with automatic feed, might well cost more than the other personal computer components combined. While a dot matrix printer might operate at speeds up to 240 character per second, a word quality printer of similiar quality might operate at about 30 characters per second (300 words per minute). Some owners of personal computers have both dot matrix and word quality printers. The dot matrix would be used for all routine printing while the letter quality printer would be reserved for "final typing". In businesses, offices, and school settings where there are multiple personal computers, one often finds a dot matrix printer supplied with each personal computer and one letter quality printer shared between several personal computers.

It should be mentioned that dot-matrix printer technology has been progressing rapidly. Most dot-matrix units have nine pins in the print head, however, units have recently been introduced with 24 pins in the print head. The quality of the better units is almost on an equal with "letter-quality" printers. This material was printed on a medium quality, nine pin print head, dot-matrix printer (cost about $500).

# PROBLEMS

A major problem with personal computers, as they exist today, is incompatibility between makes and models. Often two models from the same manufacturer will have different operating systems and cannot share diskettes even if they are the same size. If a programmer develops a program on one make and model of personal computer, often it becomes restricted to that make and model. This problem can sometimes be reduced by sending files via communications links from the CPU of one make and model of personal computer to another make or model of personal computer. This allows a nurseryman to by-pass the storage units in going from memory to memory. By using this procedure a nurseryman would at least be able to move the file from computer to computer without completely retyping it. Once in the new computer, changes might have to be made, but at least a great deal of time can be spared over starting from scratch.

In analyzing hardware, a nurseryman must consider the job to be done. Many existing personal computers have the capability of handling extensive business programs, however, it is often (depending upon the programing language being used) more difficult to write new programs using personal computers than is the case with main-frames or mini-computers. This is because micro-computers usually have less capacity and fewer internal "library" routines to help the programmer than would be the case with main-frame or mini-computers. The programmer will have to become more

efficient and will have to break lengthy programs into components that can fit the memory of machines for which one is programming.

## RECOMMENDATIONS

In the "computer world" one is always apprehensive about making recommendations - "Things change to fast". However, we will make that dangerous step, with the understanding that we are talking about October 1986. If we were contemplating purchasing a microcomputer for a nursery, we would recommend the following as a minimum hardware configuration: 1) Central Processing Unit - 16 bit, 2) Memory - 640K bytes, 3) Storage - 20 megabye hard disk plus at least one diskette drive, 4) Keyboard - One that is easy to use (note: one does not always have much choice on the keyboard once the major hardware purchase is decided), 5) Visual Display - at least medium resolution, 6) Printer - medium to high quality dot matrix, 7) Expansion - check out the possibility of adding additional memory and other features 8) Service - Be sure you can obtain rapid service for the equipment you purchase. This hardware recommendation (minimal) should get a nurseryman started. The recommend hardware configuration (if one watches for specials) could be obtained for about $3,000. We would also recommend a system that has good software support. Software and software costs can range all over the place. Some estimates are as follows: 1) Accounting - Between $500 and $1,500, 2) Word Processing - Between $200 and $600, 3) Spread-sheet - Between $200 and $700, 4) Data

base management - Between $200 and $1,000. In looking for computerware, both hardware and software, a nurseryman might want to start the investigation by checking out I.B.M. and/or I.B.M. "compatible" equipment and the software that runs on it. There is more software avaiable for I.B.M. equipment and "compatibles" than for any other type of microcomputers. A nurseryman may well find that other brands with their corresponding software will meet his/her needs as well or better, but that will only be determined through investigation.